

*R. latebrosa* Roxb. Fl. Ind. 3 : 46 ?, 1832 ; Wall, Cat. 2382, not of Roth nor of Dalz. nor of Wight.

*R. sarmentosa* Nees in Wall. Pl. As. Rar. 3 : 83, 1832.

Soft, pubescent herbs ; villous with white hairs. Stems creeping, flexuose. Leaves small, ovate, crenate. Flowers in small, close terminal heads ; pale blue in colour ; corolla long-cylindric below, upper part funnel-shaped ventricose ; bracts elliptic, bracteoles O ; calyx-lobes linear, obtuse, green. Capsule linear-obovoid, glabrous except at tip, about 12-seeded.

*Flowering and Fruiting* : April.

INDEX KEWENSIS gives India as the home of this plant. The species is confined to India and occupies a rather isolated position in the genus *Hemigraphis* Nees.

The species has not been recorded from Bombay.

#### ACKNOWLEDGEMENTS

The identification was checked in Netherlands by Professor Dr C. E. B. Bremekamp, to whom I tender sincere thanks.

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September 2, 1973.

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#### 25. HERMAPHRODITISM IN CASSAVA (*MANIHOT ESCULENTA* CRANTZ.)

(With two photographs & nine text-figures)

Cassava (*Manihot esculenta*) is an important food crop, extensively cultivated in the tropics for its tuberous roots which contain starch. Kerala is the chief cassava-growing State in India.

A large collection of germplasm consisting of about 400 varieties of this monoecious species is maintained in the Department of Botany, University of Kerala, Trivandrum. During the course of extensive studies on cassava germplasm, hermaphrodite flowers have been observed in one strain of cassava namely H. 450 (Accession No. M. 67-48). The present paper deals with detailed observations on hermaphroditism in this species, which is being recorded for the first time.

## OBSERVATIONS

As has been described by earlier workers (Rendle 1925 ; Panicker 1957), flowers in *Manihot esculenta* are hypogynous, actinomorphic and are borne in terminal compound cymose panicles. The female flowers are fewer in number compared to male flowers, usually occur at the basal part of the panicles and open first. After a week or so, the male flowers, produced in large numbers in terminal clusters, begin to open one by one in acropetal succession. This difference in maturity of the male and female flowers ensures cross pollination in nature and consequently the plants are highly heterozygous.

*Unisexual Flowers*

The majority of the flowers produced in H. 450 are unisexual. Pistillate flowers are larger than the staminate flowers and have five free perianth segments and a tricarpellary, syncarpous superior ovary on an annual slightly lobed prominent disc. In the staminate flower, the perianth is cup-shaped, five lobed above, with ten stamens in two whorls of five each.

*Hermaphrodite Flowers*

Hermaphrodite flowers having five free perianth lobes (Photo 1 and Text-fig. A) and those with fused cup-shaped perianth (Photo 2 and Text-fig. G) have been found in this variety. The hermaphrodite flowers with free perianth lobes resemble the female flowers in external appearance, the only difference being the presence of stamens in them. They are seen below the male flowers in the cymose panicle. Each flower has five free triangular perianth segments with obtuse apex (Text-figs. A & B). The perianth segments are imbricate in bud (Text-fig. F) and white in colour with greenish tint on the outside. The majority of the flowers have 10 stamens, but the number has been found to vary from 1-10 in many cases. When there are 10 stamens, they are arranged in two whorls of five each. The outer stamens have long filaments and are seen opposite the perianth lobes (Text-figs. C & D). The inner five have short filaments and alternate with the first whorl. Anthers dehisce longitudinally, those of the outer whorl introse and inner, extrose (Text-figs. D & F). About 93% of the pollen are fertile. The pistil is tricarpellary, syncarpous with superior ovary on an annular, slightly ten lobed, prominent disc (Text-fig. E). The ovary is broadly oblong, distinctly six ridged and three chambered with a solitary, pendulous, anatropous ovule in each chamber (Text-figs. B & F). The stigma is almost sessile, trifid, sticky and white in colour and each stigmatic branch divides repeatedly into many fine closely packed lobes.

A second type of hermaphrodite flower with cup-shaped perianth like the normal staminate flowers also occurs in these plants. They open

along with the pistillate flowers, earlier than the staminate flowers. The perianth is cup-shaped with five distinct lobes at the top and the cleavages

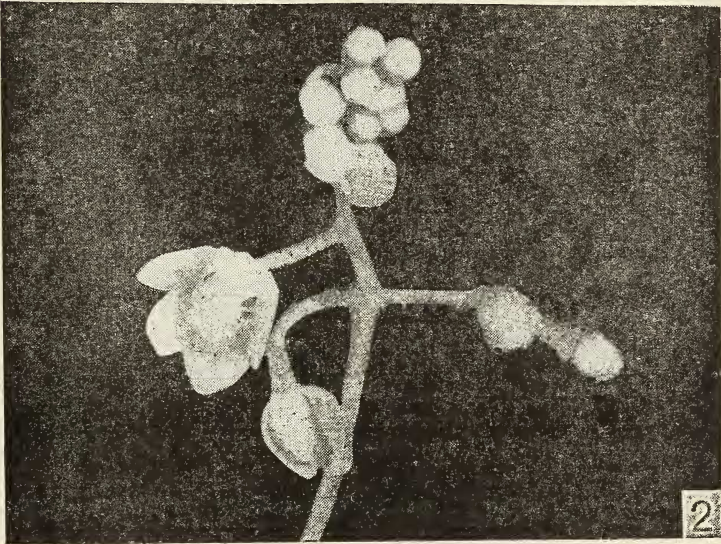
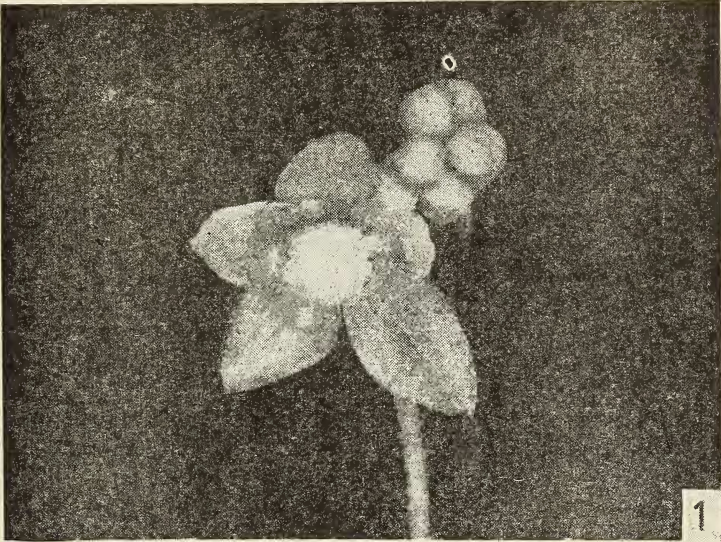


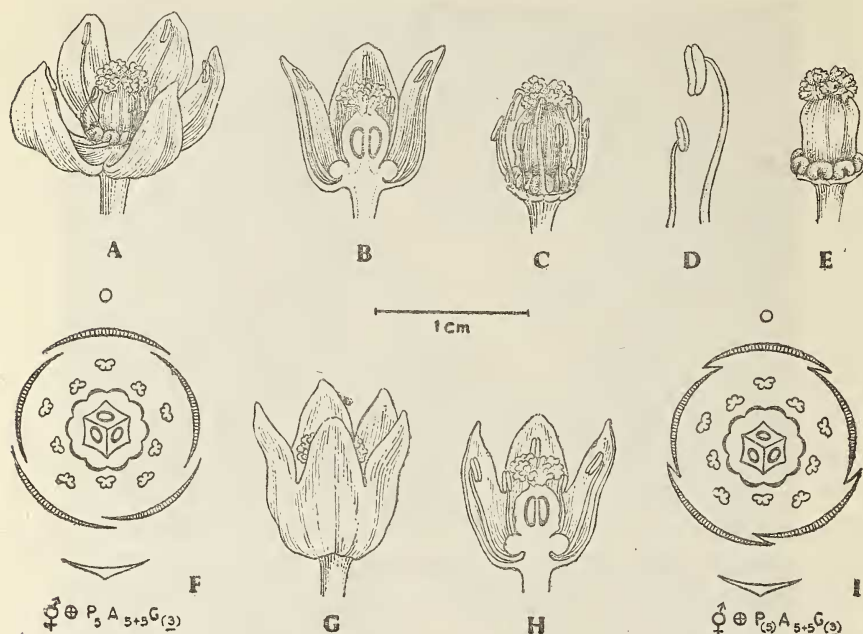
Fig. 1. A portion of an inflorescence showing a hermaphrodite flower with free perianth lobes.

Fig. 2. Hermaphrodite flower having cup-shaped perianth.

extend almost to the middle of the cup (Text-fig. G). The fused basal part of the perianth is slightly ribbed outside. The perianth lobes are white with a slightly reddish tint and imbricate in bud (Text-fig. 1).



The number and arrangement of the stamens are similar to those of the normal male flowers (Text-figs. H & I). The pistil is usually well developed, but rarely poorly developed. About 94% of the pollen are fertile.



Figures A-F—Details of hermaphrodite flowers having free perianth lobes and G-I—flowers having fused perianth. A : whole flower. B : L.S. of flower. C : flower, after removal of perianth lobes. D : stamens having long and short filaments. E : Gynoeceium. F : floral diagram. G : whole flower. H : L.S. of flower. I : floral diagram.

### DISCUSSION

Hermaphrodite flowers do not appear to have been recorded so far in *Manihot esculenta*. There are reports of the occurrence of hermaphrodite flowers in coconut, cucurbits and papaya, which like *M. esculenta* usually produce unisexual flowers. Gopala Rao (1948) observed a stray instance of hermaphrodite flowers in coconut and Davis, Anandan & Menon (1954) have reported the occurrence of hermaphrodite trees in coconut. In cultivated cucurbits where hermaphrodite female and male plants occur, genetic studies have indicated that the development of stamens and pistil is suppressed by two dominant genes 'A' and 'G' respectively, the recessive alleles of which in the homozygous conditions promotes development of plants with perfect flowers (Whitaker & Davis 1962). Papaya plants with hermaphrodite flowers are also known to be homozygous recessive (mm), the two dominant alleles  $M_1$  and  $M_2$  in heterozygous condition ( $M_1m$  and  $M_2m$ ) resulting in male and female

plants respectively (Storey 1953; Hofmeyer 1953). Plants having exclusively hermaphrodite flowers have not so far been encountered in *Manihot esculenta*. However, the regular occurrence of hermaphrodite flowers in all the ten plants in the variety H. 450 indicates that this phenomenon is possibly genetically controlled.

## ACKNOWLEDGEMENTS

This study has been made possible through the efforts of Prof. A. Abraham, University of Kerala (now in the F.A.O.) who had assembled a large collection of germplasm of root and tuber crops in this Department. The material studied by us is a hybrid evolved by him. We are grateful to him for access to this material. We are also thankful to the United States Department of Agriculture for a generous grant which enabled us to maintain and make further studies on this collection.

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